DOI: 10.13009/EUCASS2019-849

Research, education: a priority to safeguard the long-term competitiveness of European aviation

Tucci Vincenzo, Lamberti Patrizia* and Mattera Lucia**
**Dept. of Information and Electrical Engineering and Applied Mathematics (DIEM), University of Salerno, via Giovanni Paolo II 132, 84084 Fisciano (Italy)*
{vtucci, plamberti, lmattera}@unisa.it

Abstract

In order to maintain or even increase the prominent position in the world market of the aeronautic sector, the European Union has to provide continuous support to a strategic long-term vision shared by all stakeholders able of stimulating steady and notable progress. Such a long-term vision has been properly synthesized by the Advisory Council of Aviation Research in Europe (ACARE) in the 5 Challenges and 23 goals of Flightpath 2050. PARE, an EU-funded project started in Nov. 2017 aims at assessing in three yearly reports based on an open source of information the state-of-the-art concerning the achievement for each of the 23 Flightpath goals in order to highlight possible gaps and propose suitable countermeasures to overcome the problems slowing down the progress rate toward the final targets. This paper is mainly focused on the results emerged from the analysis concerning specifically Challenge 5 "Prioritising research, testing capability and education". It is highlighted that, especially for the aviation sector, the continuous support of the Education Systems and Research even at fundamental level (i.e. low Technology Readiness Level-TRL), is of paramount importance to foster industrial competiveness and to implement a sustainable development. Furthermore, it emerges that international collaborations and cooperation are essential in order to achieve the very challenging and complex goals associated to the different aspects connected to the aeronautic system ranging from the design of airplanes, to the management of flights, from safety and security issues to the recruiting of the personnel.

1. Introduction

As evidenced in many literature studies, in order to achieve long-term goals in technology, economics and societal enhancements, it is essential that governments and decisional bodies provide the necessary policies and resources. This is particularly true in the high demanding aeronautical sector where high investments are required to develop and apply leading-edge technologies contributing to the design of innovative airplanes and aeronautical structures and services. For this reason, it is important to provide the decision makers with analyses and possible recommendations, to support them in the definition and approval of regulations and investments.
The innovations induced by new technologies, products and services which has characterized, since its early-stages, the development of the aeronautic sector are the key factors of a long-term sustainable industrial and societal progress. According to this vision, the Advisory Council of Aviation Research in Europe (ACARE), in collaboration with ACI (Airports Council International), CANSO (Civil Air Navigation Services Organization), IATA (International Air Transport Association) and ICCAIA (International Coordinating Council of Aerospace Industries Associations) have identified 5 Challenges and 23 goals to be achieved by 2050 within the so-called Flightpath 2050 (FP 2050) [1].
In order to be confident that the long term challenging objectives of FP 2050 may be reached, a continuous monitoring of the progression rate towards them is to be implemented. The European Union (EU)-funded project "PARE - Perspectives for the Aeronautical Research in Europe", started in Nov. 2017 aims at assessing in three yearly reports (YR) the state-of-the-art concerning the achievement for each of the 23 Flightpath goals [2]. Such assessment is based on open-source information and is carried out in order to highlight possible gaps and propose suitable countermeasures to overcome the problems hindering the progress rate toward the final targets of the FP 2050. A schematic view of the role of PARE with respect to the 5 challenges is summarised in Figure 1.

DOI: 10.13009/EUCASS2019-849

Figure 1. Key challenges of a strategic research and innovation agenda Flightpath 2050 and PARE project

In this paper, we analyse the influence of two key factors associated to Challenge 5, *i.e.* education and research cooperation in order to find possible weak points in the current situation and identify possible interventions for speeding up the advancements towards the FP 2050 goals. The vision of future research and education is described by four main goals (goal 20 – 23) in the Flightpath 2050:

- Goal 20: European research and innovation strategies are jointly defined by all stakeholders, public and private, and implemented in a coordinated way with individual responsibly.
- Goal 21: Creation of a network of multi-disciplinary technology clusters based on collaboration between industry, universities and research institutes.
- Goal 22: Identification, maintenance and ongoing development of strategic European aerospace test, simulation and development facilities. The ground and airborne validation and certification processes are integrated where appropriate.
- Goal 23: Students are attracted to careers in aviation. Courses offered by European universities closely match the needs of the aviation industry, its research establishments and administration and evolve continuously as those needs develop.

It is evident that enhancement in aeronautics requires a cooperative methodology involving efforts from academia and industries. Moreover, as it concerns the training of the future work force in the aeronautic sector, allowing the success of all ACARE's challenges, a steady influx of young talents in the different fields of aviation professions is required.
At International Aviation Club, Washington DC (July 19, 2018), a global hub for discussing aviation, the director general for mobility and transport, highlighted that cooperation and international education and standardization, are essential tassels to fill this complicate puzzle. In particular, a high level of security means close cooperation with stakeholders – airlines, airport and international partners, hence the importance to change the mentality, and to enhance and improve international and high education, which will enrich, as consequence, the international collaboration [3].
Along this stream, a position paper from Association of European Research Establishments in Aeronautics (EREA) has stressed that it is essential to support, develop and maintain test infrastructures for new products and innovative solutions and invest on human capital source to bring in new ideas for the technological base of the European Industry. EREA, has issued recommendations for an impactful aviation research programme in the next Framework Programme, which takes into account those of "LABFAB-APP" report of the so-called High Level Group [4]. For supporting and keeping one of the most flourishing EU industries and because of the long cycles characterizing research in aviation, the investment in Research and Innovation is crucial and requires the necessary support from public funding through Grants up to TRL 6 (dashed line on Figure 2). To ensure a proper flow through the innovation chain, a certain degree of continuity is required. EREA therefore fully supports funding for Collaborative Research on TRL levels 1 to 4-5, which will keep the invaluable innovation and human capital source for one of Europe's most strategic sectors vibrant and bring in new ideas for the technological base of the European Industry.

DOI: 10.13009/EUCASS2019-849

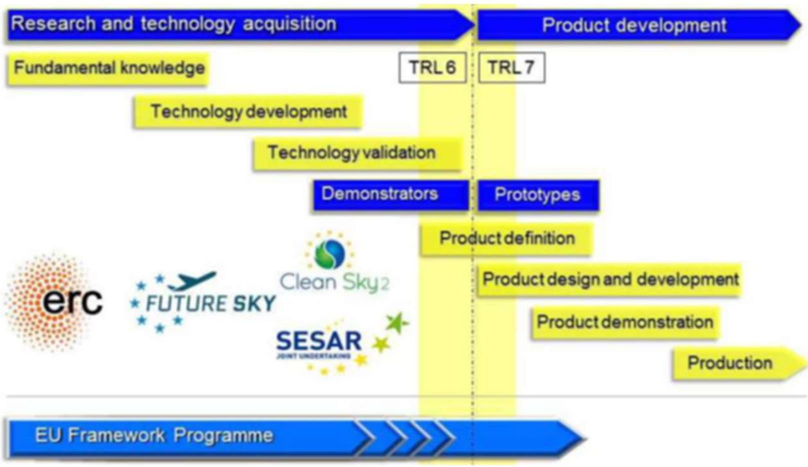

Figure 2. Innovation process needs appropriate funding

2. Methodology

Since the early Framework Programs (FP), the European Union has financed cooperative projects aimed at promoting either better young generation training through mobility programs, exchange of didactic experiences, etc., or the formation of research networks and initiatives to develop large-scale onerous and resource-absorbing demonstration and infrastructures.

As it concerns research and innovation strategies for aeronautics, by scrutinizing the EU support from FP2 to Horizon 2020, a transferral in projects funding from basic research to industrial cooperation, to large-scale demonstration to the Joint Undertakings (JU), like Clean Sky or SESAR can be pointed out. This transferral has led to a progressive disregard of basic fundamental research, which in turn is essential for fostering breakthrough new ideas required in order to ensure the accomplishment of the challenging goals of FP 2050. At the same time, comprehensive programs are needed for attracting young talent to aeronautics at all education levels, complemented by job satisfaction measures at a professional level, with special measures to promote gender equality and increase the participation of women.

The methodology applied in this work is based on the following elements:

I. Analysis of historical data concerning the support of education and research in EU.

II. Identification of future needs.

DOI: 10.13009/EUCASS2019-849

3. European Research and Innovation

The growth of the aeronautics program has shifted from (i) basic, to (ii) industrial, (iii) demonstration and (iv) integration activities. This growth should be considered as an efficient element of integral European transport system growth that “provides completely safe, secure and sustainable mobility for people and goods”. The achieved integration within a single European transport area should ease the movements of citizens and freight, reduce costs and enhance the sustainability of European transport.

3.1 General Cooperation

A network of multi-disciplinary technology clusters has been created based on collaboration between industry, universities and research institutes (EREA, PEGASUS, XNOISE, FORUM-AE, ALICANTO, etc.), including SMEs. In the short-term, attractive and efficient research instruments are put in place, which ensure continuity between research on promising breakthrough concept. Natural evolution and specialization of current clusters structure made possible to imagine the clusters around any or all of the 14 main aeronautical technologies: flight physics, aerodynamics, propulsion, structures, materials, production, control, avionics, telecommunications, computation, electrics, noise, emissions and operations.
Since their initiation in 1984, seven FPs have been launched, and continued in the 8th EU FP, named Horizon 2020, launched in 2014. In Figure 3, a view elaborated from [5] of the number of projects and involved number of participants from FP2 to FP7 is provided. In the cited paper the authors have also shown the evolution of the relevance (in terms of number and funds) of the different topics investigated in the EU funded projects.

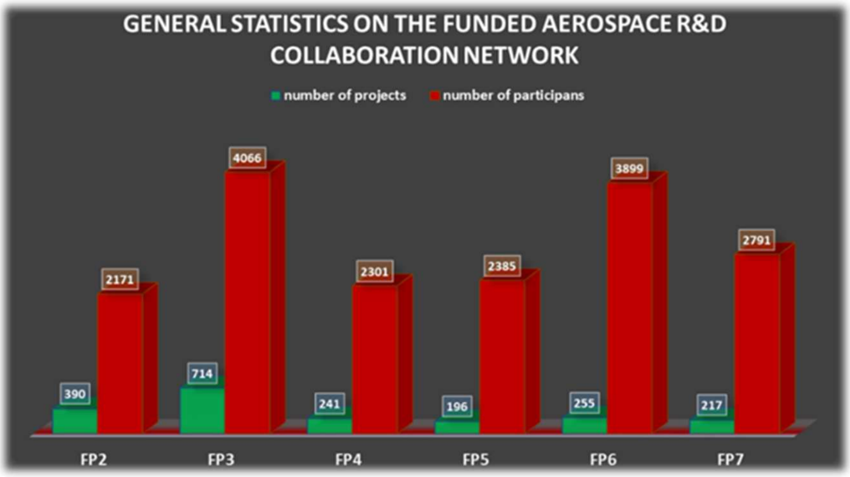

Figure 3: General information concerning the aerospace sector funded from FP2 to FP7 in the time period 1987 to 2013

The data are obtained from the EUPRO database[1], and in particular, by considering 2013 projects dedicated to the aerospace sector, which are mapped in 25 thematic categories, as shown in Table 1.

[1] EUPRO database is developed and maintained by Austrian Institute of Technology, Innovation Systems Department by standardizing raw data on EU FP research collaborations collected from the CORDIS database

DOI: 10.13009/EUCASS2019-849

:

Table 1: Thematic categories used to classify the EU funded projects related to the aeronautic sector

Code	Thematic explanation
AER	Aerodynamic, flows and aero thermic
ALO	Alloys and coatings, glazed materials and paints
CEG	(Technical) ceramic and glasses
CHE	Chemical processing (incl. petrochemicals)
COM	Composite materials
ELE	Electric and electronic (incl. cables and conductors)
FCH	Fuel cells, batteries, liquid hydrogen, cathodes and membranes
FOR	Forming, moulding, winding, sintering and grinding
LIT	Rare-earth materials (e.g. lithium)
LSO	Lasers, sensors and optics
MET	Metals (steel, aluminum, copper, titanium,. . .)
MIN	Mining (incl. all auxiliaries)
OMA	Other materials (e.g. rubber, leather, resins, wood, concrete, biomaterial,. . .)
OMP	Optimizing manufacturing processes, production and products (incl. cost reduction)
OTH	Others
PLA	Plastics and polymers
REC	Recycling and environmentally friendly product improvements and processes
ROB	Robotic systems, e.g. for production, inspection, . . .
RSY	Quality and safety systems (incl. repair systems, non-destructive detection, maintenance, etc.)
SAC	Sawing and cutting
SAT	Satellites and space topics
SIM	Simulation, numerical models, computer-aided systems, informatics
SUR	Surfaces
TXT	(technical) textiles
WEL	Welding, soldering, brazing

The historical development of projects is shown in [5].

In FP2 and FP3 (from mid-1980s to the mid-1990s) the most relevant topic was on composite materials. In fact, during this period many R&D efforts have been devoted to the development of new polymer composites in response to the aircraft manufacturers demand to reduce its weight in order to decrease fuel consumption and increase the airplane flight range.
It is worth reminding that until the mid-1990s the amount of employed composites was around 10% of the total aircraft weight and limited to non-structural parts. This percentage has sensibly increased up to the actual 50% in Boeing 787 and Airbus A350 recently introduced in the aircraft market (in 2011 and 2015, respectively). This observation evidences that there has been an industrial application of new technologies has nearly 20 years lag with respect to the research and development phase.
The most relevant topics of FP4 concerning efficiency and optimization of aircraft design and procurement costs were continued in FP5. In addition, specific goals concerning the reduction of aircraft noise and climate impact become of greater importance. During the exploitation period of FP5, the improvement of aircraft operational capability is put in evidence by the increased number of projects dedicated to computer-aided systems. In FP6, the most relevant efforts have been associated to safety and security, cost reduction, improvement of the environmental impact with regard to emissions and noise. The EU strategy in FP7 concerning aerospace has been concentrated on the reduction of emissions and alternative fuels (REC), air traffic management, safety and security (RSY) and efficient aircraft production. In fact, it is worth to mention that during FP7 at least €4 billion were be allocated to fund EU research aimed at developing safer, "greener" and "smarter" transport.
Furthermore, as pointed out by a recent report of the EU about research in the EU-13 countries (since 2004 there have been 13 new countries added to the European Union. The group of EU-13 countries includes: Bulgaria (BG), Croatia

DOI: 10.13009/EUCASS2019-849

(HR), Cyprus (CY), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Malta (MT), Poland (PL), Romania (RO), Slovakia (SK) and Slovenia (SI)), despite the efforts made by politics, institutions and industry, the participation of individual EU-13 countries in European research initiatives is very heterogeneous but underperforming [EPRs/ European Parliamentary Research Service. Scientific Foresigth Unit (STOA) [6]. The results reported in a recent paper focused on ACARE Challenge 3 [7] confirm that, regardless of the efforts done, there is still a gap for the effective integration of the aeronautical potential research capabilities of EU-13 countries into the European scheme. This represents another gap to be filled. A collaborative approach is key to achieving these goals. In fact, one of the main challenge is to determine how to ensure the sustainable growth of the sector. Thus the importance to achieve the 17 United Nations Sustainable Development Goals (17SDGs), in particular for aviation, as priority and example Worldwide [8].
Since to achieve any set goals by year 2050, measure to promote international collaboration networks and research structures need to be taken now, thus, this is true, in particular, to achieve the 17 SDGs by year 2030.
A summary of FP6 and FP7 projects focused on improving the EU-13 participation in FPs is presented in reference [9]. Among others, the BEWARE project aims at supporting potential coordinators and potential partners in future R&D projects in the field of Aeronautics and Air Transport of Horizon 2020. Moreover, it intends to identify innovation opportunities and building international teams and consortiums and to increase the participation of Eastern European regions in pan-European research activities through Horizon 2020 in the field of Aeronautics and Air Transport. The BEWARE consortium connects leading aerospace clusters and support organisations in Western Europe (France, Germany, United Kingdom, Spain and Italy) with quickly evolving aerospace clusters and strongholds in Eastern Europe (Poland, Romania, Czech Republic, Slovakia and Baltic States). Thus, the BEWARE project creates the necessary conditions for utilizing the existing and emerging potential in the field of Aeronautics and Air Transport for a continuous and sustainable contribution in European aerospace programmes and projects by promoting collaborative projects in the field of Aeronautics and Air Transport.

3.2 Test, Simulation and Development Facilities

Research and development infrastructure is an indispensable tool to achieve a decisive competitive edge in developing sustainable aviation products and services that meet the needs of citizens and society. Appropriate core capabilities are available and accessible, the rationalization of smaller scale test facilities has diminished duplication, and it may be time to look at updates. Some good examples are: (i) the joint DutchGerman aero-acoustic wind tunnel DNW; (ii) the joint British - French-German cryogenic pressurized wind tunnel ETW; (iii) the choice of CIRA to build an icing wind tunnel and an atmospheric re-entry simulation facility [10 - 12].
As an example, the European Transonic Wind Tunnel, ETW, which is located in Cologne, Germany (Figure 4) is a brilliant example of aeronautic infrastructure derived from international collaboration and cooperation. It has been realized by the joint efforts among the major aerospace research agencies, i.e. Germany (DLR), France (ONERA), the United Kingdom (DRA), and the Netherlands (NRL). The ETW was established in 1988 as a European equivalent to the NASA National Transonic Facility (NTF) cryogenic wind tunnel in Hampton, VA.
ETW is one of the world's largest and modern cryogenic wind tunnels, and a unique test facility for the development of new transport aircraft. It provides a large Reynolds number transonic wind tunnel facility. By applying low temperature operation, ETW is capable of accurately simulating actual high-lift and high-speed flight conditions of modern transport aircraft. A key feature is its ability to match the respective high Reynolds number, which cannot be achieved in conventional wind tunnels at ambient temperature.
However, there is still a great gap for the effective integration of the EU programs in a no fragmentation framework, which is a main issues concerns for the next FP9 [13] as described in goal 23.

Figure 4. ETW wind tunnel

DOI: 10.13009/EUCASS2019-849

4. Education

In order to allow the success of all ACARE's challenges a steady influx of young talents in the different fields of aviation professions is required. A well-functioning research and innovation system is important for promoting excellence in education and skills development and ensuring a sufficient supply of graduates and postgraduates in STEM (science, technology, engineering and mathematics). Increasing the number of science graduates and jobs in knowledge-intensive activities would help to create a solid base for the EU knowledge economy and contribute to Europe 2020's objectives by fostering the EU's innovation capacity, economic strength and employment. A general picture of the trends of some indicators which include two related to the education-needs issue in EU is shown in Figure 5. The data are obtained from Eurostat, the statistical office of the European Union, based on data reported by the countries and data source by ESS Labour Force Survey (LFS) which has elaborated indicators (i.e., employment rate - age group 20-64; gross domestic expenditure on R&D; greenhouse gas emissions; etc., as shown in Figure 5 produced according to the high-level quality standards of European Statistics by using the NComVA visualization system [14]. The common denominator is that these indicators are, inter alia, parts of the indicators sets:

a) EU Sustainable Development Goals (SDGs) indicators set where they are used to monitor progress towards the 17SDGs.
b) EU 2020 strategy indicators where they are used to monitor progress towards the EU's target, in particular, of increasing the employment rate of the population aged 20 to 64 to at least 75 % and climate change by 2020.

Furthermore, an important indicator (employment rate - age group 20-64) such as is part of the impact indicators for Strategic plan 2016-2020 referring to the 10 Commission priorities, and included as main indicator in the Social Scoreboard for the European Pillar of Social Rights. In fact, employment contributes, inter alia, to economic performance, quality of life and social inclusion, making it a cornerstone of socioeconomic development and well-being in order to achieve the 17SDGs [14]. Since 2008, positive developments are also visible in the area of education (through the increase in the rate of tertiary educational attainment and the reduction in the number of early leavers from education and training). Progress that is more limited has been reached for R&D expenditure as well as for employment.
The European strategy for aviation Flightpath 2050 envisaged, inter alia, that by 2050 the region should reinforce the education including the proper training in the so called STEM subjects [13].
The European Research Council (ERC) has sponsored high-quality research in basic science, including mathematics and physics, with some underrepresentation of engineering. Fundamental and applied research in various scientific disciplines (such as fluid mechanics, materials, structures and systems) and the development of sub-components and components (like engines) and aeronautical end-products (including fixed-wing aircraft and rotorcraft) has always been associated with extensive design, computation, testing, optimisation and validation activities [15].
Furthermore, the European Parliament called on the Commission to provide more support in FP9 'for young researchers, such as pan-European networking tools and to reinforce funding schemes for early-stage researchers with less than two years of experience after PhD completion. In fact, it is well known that the major demographic trend in Europe is characterised by an aging population and declining younger age cohorts. This feature is in contrast with the goal 23. It represents, therefore, a gap to be filled and in this paper we will try to found some links to overcome this problem.

DOI: 10.13009/EUCASS2019-849

Figure 5. Trends of indicators concerning aspects related to the development of the education system in EU [14].

4.1 Young Talent and Women in Aviation

The ACARE Strategic Research and Innovation Agenda (SRIA) challenge relevant for the Goal 23 is dedicated to Infrastructure and Skills aiming to ensure the preservation of Europe's research infrastructure requirements and encourage a sustained flow of competent, trained and motivated people.
ACARE has developed a plan to establish in Europe a fully integrated aviation education system, which will deliver the required high-quality workforce, with the skills and the motivation to be able to meet the challenges of the future. This requires a harmonised and balanced approach covering the entire scope from attracting talents over primary and secondary education to apprenticeship, academia and lifelong professional development. ACARE settles three actions relevant for this analysis, indicated in the Table 2.

- Action Area 5.6 – Provide world-leading education in aviation;
- Action Area 5.7 – Stimulate the involvement of stakeholders in education;
- Action Area 5.8 – Make aviation attractive to ensure inflow into educational programmes.

Table 2: Status relative to the ACARE Goal 23

Action Areas	Target State 2050	Desirable Progress
5.6 - Provide world-leading education in aviation	European aviation education is world-leading, providing excellent support to the aviation sector. Programmes are harmonised with European	By 2025, the means for harmonisation across European aviation education should be defined, with

DOI: 10.13009/EUCASS2019-849

	accreditation schemes and a chartered aerospace engineer qualification.	implementation following shortly after. European accreditation should be in place in 2035. As well, the qualification of chartered aerospace engineer should also be available.
5.7 - Stimulate the involvement of stakeholders in education	Industry and research establishments are fully involved in educational programmes ensuring that students are better prepared for a career in aviation. Industry is reaping substantial benefits form this collaboration, which extends to apprenticeships and life-long learning.	Internships, placements and subject matter for masters and doctoral students; staff exchanges; greater number of industry-funded university chairs
5.8 - Make aviation attractive to ensure inflow into educational programmes	The image of the aviation sector is positive and attractive. Sufficient number of people flow into the educational programmes and choose a career in aviation. This supports European aviation as world leader.	Awareness programmes for schools should be in place from 2020 onwards. By 2025 there should be a system of grants for outstanding students who wish to join aviation programmes from within and beyond Europe. A European XPRIZE in aviation should also be organised in 2025.

SRIA analyses several keys aspects and areas to be promoted until 2050. The key message is that educational policies across the EU motivate students to pursue further studies in STEM to ensure a steady supply of talent for a first-class work force. Such issues can be also framed in the new ICAO and United Nations (UN) Sustainable Development Goal (SDGs) (Figure 6). In particular, goals 4 and 5 are clearly related to the education issue [8].

Figure 6: ICAO and the UN Sustainable Development Goals (SDGs) – Agenda 2030

Broadly speaking, according to the 2030 Agenda there can be no sustainable development without quality education and gender equality. Thus it is of outmost importance to encourage research organisations to be the agents of change, taking practical steps to eliminate any remaining bias which prevent or hinder women from entering, or fulfilling their potential in research careers. To this end a lot of project are ongoing and submitted. In particular, since 2003, the She Figures's project have monitored new developments related to careers, decision-making and how the gender dimension is considered in research and innovation content. A lot of European women are excelling in higher education, and yet, women represent only a third of researchers and around a fifth of grade A, top-level academics. Although the number of female heads of higher education institutions rose from 15.5 % in 2010 to 20 % in 2014, there is clearly still a long way to go before we reach gender equality in European research and innovation professions [16]. Broadly speaking, the number of science and technology graduates in the EU is increasing, but women remain underrepresented (Figure

DOI: 10.13009/EUCASS2019-849

7). Despite the growth of female tertiary graduates in science and technology over the same period, women still remain underrepresented in these fields [17].

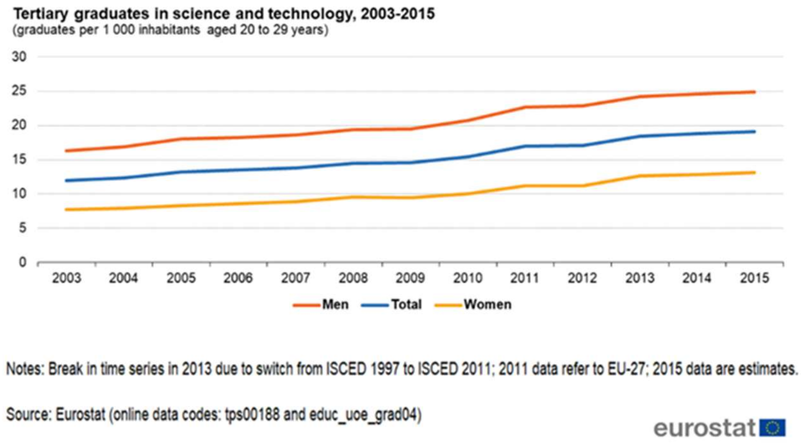

Figure 7: Tertiary graduates in science and technology, 2003-2015.png [17]

4.2 Education and human resources needs in the aeronautical sector

The aerospace sector is characterized by strong volume growth with an estimated production of 25,000 aircraft in the next 20 years, the industry must attract qualified engineers and skilled blue-collar workers, as well as pilots and technicians. According to Alix Partners [18] European aerospace and defence industry is expected to require at least 12 500 engineers yearly. The demand for highly skilled people is expected to increase intensely. For example, the number of U.S. jobs that require complex interactions involving a high level of judgement has grown three times as fast as employment in general. ICAO estimates that 350 000 new pilots and 480 000 new technicians will be needed by 2026 to keep these planes operational.
Aerospace and defence sector (A&D) employment in Europe by 2015 accounted for 552 000 aeronautic employees and up to 38 000 space employees, being the distribution by tasks comparable in Europe and the United States. More detailed statistics are available from the United States Department of Labor, Bureau of Labor Statistics.
Concluding, since the demand for professional engineers and technicians is expected to grow in all levels of the value chain it is important to highlight that airline operators must consider strategies to recruit pilots in a more competitive and constrained environment. Boeing estimates U.S. airlines will demand about 95,000 pilots in the next 20 years. Europe is expected to need 95,000 pilots, and Asia will likely need 226,000.
In order to face the demand for aviation professionals, which will exceed supply, ICAO asked for globally-harmonized solution including human resource planning tools, accredited training and educational programmes adapted to the next generation, and wide-ranging cooperation among concerned stakeholders. Therefore, ICAO established the Next Generation of Aviation Professionals Task force (NGAP), consisting of 29 representatives from industry, education and training providers, regulatory bodies and international organizations [19]. The NGAP initiative is intended to ensure that qualified and competent aviation professionals are available to operate, manage and maintain the future international air transport system. The Task Force also aims at supporting initiatives relating to the next generation of aviation professionals since:

- a large contingent of the current generation of aviation professionals will retire
- access to affordable training and education is increasingly problematic
- aviation competes with other industry sectors for highly skilled professionals.

Under this initiative, several actions have been carried out in the time period 2011-2015, as shown in Figure 8.
More recently (2016 – 2017), has also worked on the following relevant actions [19]:

- New Fundamentals of the Air Transport System course
- New Aviation Training and Education Directory
- Updated aviation personnel forecasts

Moreover, in December the International Association of Aviation and Aerospace Education (ALICANTO) has been created as an initiative to fill an important gap in air transport's global cooperation framework [20]. ALICANTO groups 34 of the world's prominent aviation and aeronautical universities. The universities agreement recognizes that

DOI: 10.13009/EUCASS2019-849

their participation and input is critical in order to identify and implement effective approaches to attract, educate and retain the next generation of aviation professionals. The Chinese Society of Aeronautics and Astronautics (CSAA), the Aerospace College Alliance of Sino-universities (ARCAS), the Partnership of a European Group of Aeronautics and Space Universities (PEGASUS), the Romanian Aeronautical Association/European Aviation Institute and the Directorate General of Civil Aviation of Turkey also support ALICANTO. This initiative is in line with the next FP9 focus on international collaborations, educations and the achievement of the 17 SDGs and with the ACARE Challenges, thus PARE’s goals.

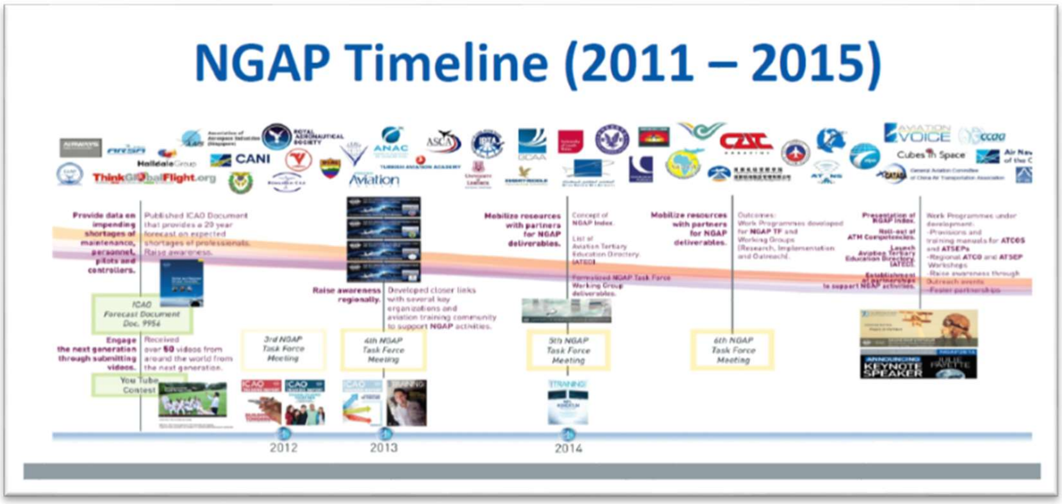

Figure 8: NGAP initiatives for new generation of aviation professionals task force.

As mentioned before, another problem is that the major demographic trend in Europe is characterised by an aging population and declining younger age cohorts. Is therefore important that airline operators must consider strategies to recruit pilots in a more competitive and constrained environment. This could entail developing programs with vocational or collegiate flight schools, developing more formalized feeder programs with regional partners, or financing the next generation of qualified pilots. However, these options are also costly. The smart airlines are exploring stronger, scalable relationships within the pipeline, namely with pilot training organizations.
Part of the solution to achieve this goal is to ensure that girls and women are better aware of the personal and professional growth opportunities.
Broadly speaking, in order to attract more girls and younger talent to consider a future in aviation or more in general to study STEM subjects, some key action are listed in the following:

- Promote gender equality (5-SDGs).
- Give girls and boys, in primary and secondary schools the same opportunities to choose their games and entertainment.
- Adopt a neutral attitude to avoid “gender discrimination” in children education.
- Tackle the stereotypes that girls aren’t as capable in STEM.
- Discourage and prevent continuation of abuse based on gender.
- Respect for family values and culture should be part of company / institution ethics not only to steering in STEM carrier.
- Provide good practices improving balance of professional / personal life, flexibility and time compensation on companies.

The above discussion highlights that the future actions will continue to stress the importance of involving women at all levels and dimensions of aeronautics research and in STEM as a key element to achieve the ACARE Challenges. The common denominator to attracting young talent and steering women to STEM, inside and outside school is to change the mentality and philosophy of intuitions, starting since childhood. Encourage greater participation of women in conferences, events, prize and competitions.

DOI: 10.13009/EUCASS2019-849

5. Conclusions and recommendations

EU aerospace research towards Flightpath 2050 goals faces several challenges. It is clear from available studies that these goals cannot be fully achieved using evolutions of currently available technologies. The ambitious goals set for Flightpath 2050 can only be achieved through equally ambitious strategies and actions. Basic research can play a key role here. The timeframe to 2050 leaves scope to mature what is now low TRL basic research to promising high TRL demonstrations and feasible solutions to meet aviation targets. This requires new and breakthrough technologies often originating in universities, SMEs and small laboratories, identifying the most promising ones, some of which may be ahead of their time. Thus, in this paper we have highlighted the need to strengthen this network.
In order to cope with the challenges and opportunities the short-term European strategy implemented in the new FP9 funding program should reinforce the prioritizing research, testing capabilities and education in aviation and STEM. To achieve this, it will be necessary to stress high priority recommendations to support a broad program with a wide variety of low-cost applied basic research, to bridge the gap between the fundamental research and near-market driven focus. PARE recommendation 20 asks for a broad program with a wide variety of low-cost applied basic research up to TRL3, to bridge the gap between the fundamental research of ERC and near-market driven focus of JUs ensuring that Europe does not miss out the promising new ideas.
Moreover, it is recommended a balanced and proportionate support of 4 levels of projects: (a) basic; (b) collaborative industrial; (c) large-scale demonstrators; (d) joint undertakings.
Research and development infrastructure is addressed by goal 22, as an indispensable tool to achieve a decisive competitive edge in developing sustainable aviation products and services. The advantage, in the era of Industry 4.0 is that companies, departments, functions, and capabilities will become much more cohesive thanks to the universal data-integration networks, hence they are in line with the new FP9 programme, to reinforce and create international and multidisciplinary network. Further studies should look in more detail the best solution to harmonize and achieve these fundamental goals.
Finally, concerning goal 23, aerospace and defence sector employment in Europe is expected to require at least 12 500 engineers yearly, 350 000 new pilots and 480 000 new technicians in the coming years. Important initiatives have been already put in place. National cluster units and the new European Aerospace Cluster Partnership (EACP) established opportunities to develop and expand transnational education and training programmes. However, it is important to foster a comprehensive program of attraction of talent to aeronautics to all education levels, complemented by job satisfaction measures at professional level, with special measures to promote gender equality and increase the participation of women. The attraction of young talent to aeronautics should focus equally on both genders, start with the fascination of flying in youngsters, and continue with access to high-quality diversified university courses, followed by challenging and interesting careers in industry.

References

[1] Industry High Level Group (IHLG). AviationBenefits2017; Industry High Level Group (IHLG); ACI (Airport Council International); CANSO; IATA (International Airlines Transport Association); ICAO (International Civil Aviation Organization): Montreal, QC, Canada, 2013; Available online: https://www.iata.org/policy/documents/aviation-benefits-%20web.pdf (accessed on 6 April 2019)
[2] PARE Consortium. PARE Project. Available online: www.pareproject.eu (accessed on 12 December 2018)
[3] Henrik Hololei/International Aviation Club, Washington DC 2018. Challenges for Aviation
[4] LAB – FAB – APP — Investing in the European future we want (2017)
[5] Guffarth, M. J Barber, (2013): The European aerospace R&D collaboration network, FZID Discussion Paper, No. 84-2013, http://nbn-resolving.de/urn:nbn:de:bsz:100-opus-9038
[6] Overcoming innovation gaps in the EU-13 Member States. STUDY. Science and Technology Options Assessments. PE 614.537,» 2018
[7] Rosa Maria Arnaldo Valdes et al., Flight Path 2050 and ACARE Goals for Maintaining and Extending Industrial Leadership in Aviation: A Map of the Aviation Technology Space. April 2019. Sustainability 11 (2065); doi: 10.3390/su11072065
[8] UN women 2018- 2030-Agenda-for-Sustainable-Development-2018
[9] EPRs (European Parliamentary Research Service). Scientific Foresigth Unit (STOA). Overcoming innovation gaps in the EU-13 Member States. Study. Sci. Technol. Options Assess. 2018
[10] CIRA ICING WIND TUNNEL USER MANUAL Chapter 11 20 D
[11] Green Regional Aircraft (GRA) | Clean Sky (http://www.cleansky.eu/green-regional-aircraftgra)

DOI: 10.13009/EUCASS2019-849

[12] Jorge Niosi. (2012) R&D Support for the Aerospace Industry A Study of Eight countries and One Region 2012. The Aerospace Review
[13] EASN_2018_KeyNotes_Glasgow_011055
[14] https://ec.europa.eu/eurostat/web/europe-2020-indicators/visualisations
[15] The Global Gender Gap Report, 2017
[16] European Commission, She figure 2015 project
[17] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Tertiary_graduates_in_science_and_technology,_2003-2015
[18] It's All About People, The Battle for Talent in the Aerospace and Defence Industry, January 2013)
[19] www.icao.int/ngap
[20] https://www.icao.int/Meetings/ngap2018/Presentations/Modified%20Alicanto%20Presentation%20NGAP2_V7%20-%20for%20Signing%20Ceremony.pdf